CERTIFICATION

I, Junji Morimoto; Twin 21 MID Tower 34F 1-61, Shiromi 2-chome Chuo-ku, Osaka 540-6134, Japan, hereby certify that I am the translator of the accompanying certified official copy of the document in respect of an application for a patent filed in Japan on the 4th day of September 2000 and application number is 2000-266847, and certify that the following is a true and correct translation to the best of my knowledge and belief.

Junji Morimoto

Junji Morimoto

Dated this 15th day of February 2006

[Document Name] Patent application

[File Number] F1G10874

[Filing Date] September 4, 2000

[Addressed to] Honorable Commissioner of Patent Office

[International Patent Classification] B60K 17/08

[Inventor]

[Address] c/o KANZAKI KOKYUKOKI MFG. CO., LTD.
2-18-1 Inadera, Amagasaki-shi, Hyogo

[Name] HASEGAWA Toshiyuki

[Applicant]

[Discrimination Number] 000125853

[Address] 2-18-1 Inadera, Amagasaki-shi, Hyogo

[Name of the company] KANZAKI KOKYUKOKI MFG. CO., LTD.

[Representative Director] YAMAOKA Kojiro

[Attorney]

[Discrimination Number] 100080621

[Patent Attorney]

[Name] YANO Juichiro

[Telephone] 06-6261-3047

[Indication of the Fee]

[Fee file number] 001890

[an amount of fee] 21000

[Attachment]

[Name] Specification 1

[Name] Drawing 1

[Name] Abstract 1

[Document Name] Specification

[Title of the Invention]Transmission of Truck

[Claims]

[Claim 1] A transmission of a truck, the truck including an engine mounted on a bodywork frame such that a crankshaft of the engine is horizontally oriented perpendicular to the longitudinal direction of the truck, the transmission comprising:

an input shaft for receiving power of the engine through a continuously variable transmission;

an output shaft disposed in parallel to said input shaft;

a pair of axles extended oppositely to each other and in parallel to said output shaft;

a differential connecting said axles with each other in a differential manner;

a transmission casing containing said input shaft, said output shaft, said pair of axles and said differential;

a pair of left and right axle housings mounted onto respective left and right faces of said transmission casing, wherein said pair of left and right axle housings house said pair of left and right axles, and wherein said pair of left and right axle housings include mounting portions to be mounted onto the bodywork frame; and

a wet-type disc brake device provided around a portion of said left and right axles covered by said left and right axle housings.

[Claim 2] The transmission of a truck as set forth in claim 1, wherein said input shaft is eccentrically disposed from said axles toward said engine.

[Claim 3] The transmission of a truck as set forth in claim l, further comprising:

a drive train which can switch the rotational direction of said output shaft in relation to the rotational direction of said input shaft, wherein one axial

side portion of said output shaft is drivingly connected to said input shaft through the drive train;

an output rotary member provided on the other axial side of said output shaft;

an input rotary member of said differential, wherein said output rotary member is drivingly connected to the input rotary member; and

a centrifugal governor for changing output of the engine according to variation of rotational speed of said input shaft, wherein said centrifugal governor is disposed on a portion of said input shaft facing said output rotary member.

[Detailed Description of the Invention]

[0001]

[Technical field to which the invention belongs]

The present invention relates to a transmission with a belt-type CVT (Continuously Variable Transmission), which is available for a truck.

[0002]

[Prior Art]

Conventionally, there is a well-known truck driven by transmitting rotation of an engine to an axle, including a belt-type automatically variable transmission (CVT) between an output shaft of the engine and an input shaft of another transmission. In this structure, the CVT is provided with a sensing means for detecting rotary speed or load of the engine, so that the speed reduction ratio of the CVT is automatically reduced according to increase of rotary speed of the engine (i.e., reduction of load), and increased according to reduction of the rotary speed of the engine (i.e., increase of load).

In addition, there is a conventional well-known layout that an engine is mounted sidewise so as to orient its crankshaft perpendicular to the longitudinal direction of the vehicle and in parallel to an input shaft of a

transmission, an output shaft of the transmission, and axles. This described vehicle structure especially facilitates interposing a belt-type CVT between the crankshaft of the engine and the input shaft of the transmission because both shafts are parallel to each other. Moreover, the transmission in this vehicle structure may transmit power via economical spur wheels because shafts therein are disposed parallel to one another. Therefore, the vehicle structure is advantageous in contributing to the reduction of assembly and manufacturing costs.

[0003]

An object of the invention is to provide a transmission for a truck such that the truck can be simply and economically produced for mounting the transmission thereon.

[0004]

The above object is achieved by the invention with the following means:

[0005]

As claimed in claim 1, in a truck including an engine mounted on a bodywork frame such that a crankshaft of the engine is horizontally oriented perpendicular to the longitudinal direction of the truck, a transmission of the truck comprises: an input shaft for receiving power of the engine through a continuously variable transmission; an output shaft disposed in parallel to the input shaft; a pair of axles extended oppositely to each other and in parallel to the output shaft; a differential connecting said axles with each other in a differential manner; a transmission casing containing the input shaft, the output shaft, the pair of axles and the differential; a pair of left and right axle housings mounted onto respective left and right faces of the transmission casing, wherein the pair of left and right axle housings house the pair of left and right axles, and wherein the pair of left and right axle housings include mounting portions to be mounted onto the bodywork frame; and a wet-type

disc brake device provided around a portion of the left and right axles covered by the left and right axle housings.

[0006]

As claimed in claim 2, in the transmission of a truck according to claim 1, the input shaft is eccentrically disposed from the axles toward the engine.

[0007]

As claimed in claim 3, the transmission of a truck according to claim 1 further comprises: a drive train which can switch the rotational direction of the output shaft in relation to the rotational direction of the input shaft, wherein one axial side portion of the output shaft is drivingly connected to the input shaft through the drive train; an output rotary member provided on the other axial side of the output shaft; an input rotary member of the differential, wherein the output rotary member is drivingly connected to the input rotary member; and a centrifugal governor for changing output of the engine according to variation of rotational speed of the input shaft, wherein the centrifugal governor is disposed on a portion of the input shaft facing the output rotary member.

[0008]

[Embodiment of the Invention]

An embodiment of the invention will now be described.

Fig. 1 is a general side view of a truck to which a transmission of the present invention is applied; and Fig. 2 is a sectional rear elevation showing the general structure of the transmission and axles; and Fig. 3 is a grossly enlarged sectional rear elevation showing the structure in a transmission casing.

Fig. 4 is a side view of the transmission; Fig. 5 is a sectional side view of the transmission; and Fig. 6 is a sectional side view of the transmission when modified axle housings are attached.

[0009]

A general structure of the truck as an embodiment of the present invention will be described with reference to Fig. 1.

A bodywork frame 10 is disposed in the longitudinal direction of the truck 1. An engine 3 is mounted on the bodywork frame 10 at a position downwardly rearward of an operator's seat 2. The engine 3 is disposed so as to make its crankshaft 6 horizontal.

At the rear of the engine 3, a transmission 4 of the present invention is supported by the bodywork frame 10 through a pair of later-discussed axle housings 80. A pair of left and right slender flat boards are extended in the longitudinal direction of the truck and in parallel to each other, and the rear end portion of the flat boards are connected with each other, thereby forming the bodywork frame 10 having a U-shape in a plan view. The axle housings 80 are fixed onto the bodywork frame 10 such that a transmission casing 31 of the transmission 4 is located between the left and right flat boards.

A cargo deck frame 10a on which a cargo is mounted is disposed above the transmission 4 and the engine 3, and is supported by the bodywork frame 10.

[0010]

The transmission 4 includes an input shaft 5 projecting either leftward or rightward. The input shaft 5 is connected to the output shaft 6 of the engine 3 through a belt-type automatically continuous variable transmission (hereinafter referred to as "CVT") 7. Further, the transmission 4 includes a pair of left and right rear axles 8 projecting laterally outward. Rear drive wheels 9 are fixed on respective outer ends of the rear axles 8.

A front axle casing (not shown) is supported at a front portion of the vehicle. The front axle casing houses a pair of left and right front axles 11, and a differential (not shown) differentially connecting the front axles 11 with each other. Each of the front axles 11 supports each of front wheels 12 at its

outer end. The front wheels 12 can be steered by operating a steering wheel 13 projecting in front of the operator's seat 2.

[0011]

A forward/backward travel direction switching lever 19, which is operated to select whether the travel direction of the vehicle is forward or backward, is disposed on a side of the steering wheel 13. An accelerator pedal 21 is provided in front of the operator's seat 2, and is linked with a throttle valve (not shown) which adjusts the volume of injected fuel. By changing the degree of opening of the throttle valve according to degree of depressing of the accelerator pedal 21, the rotary speed of the engine 3 can be increased or reduced.

The power of the engine 3 is transmitted into the transmission casing 31 from the output shaft 6 of the engine 3 through the CVT 7 and the input shaft 5, and passes through a power train in the transmission casing 31, and is finally transmitted to the rear wheels 9 through the rear axles 8, thereby driving the truck 1.

A pair of brake devices 22 for braking the respective axles 8 are provided in the transmission casing 31. Each of the brake devices 22 is operable by each of a pair of brake control arms 23 pivoted on the respective left and right outside walls of the transmission casing 31. The brake control levers 23 are interlocked with a single brake pedal (not shown) disposed in the vicinity of the accelerator pedal 21, such that the left and right rear axles 8 are braked simultaneously by depressing the brake pedal.

[0012]

Next, description will be given on the interior structure of the transmission 4 equipped on the truck 1 constructed as the above in accordance with Fig. 2.

[0013]

The transmission casing 31, which houses the transmission 4, is

formed of a pair of left and right casing halves 31 and 31, which are joined to each other at their vertical flat and peripheral joint faces. Inside the joined portions of transmission casing 31 are disposed the left and right rear axles 8, a differential 32 differentially connecting the left and right rear axles 8, and a forward/backward travel direction switching mechanism 35 operated by the forward/backward travel direction switching lever 19, and so on.

[0014]

The input shaft 5 is laterally and rotatably supported at a vertically intermediate portion of the transmission casing 31. One end of the input shaft 5 projects laterally outward from the corresponding side of the transmission casing 31. A driven split pulley 36 is provided on the outward projecting portion of the input shaft 5, such that the driven split pulley 36 serves as an output section of above-mentioned belt-type CVT 7.

The driven pulley 36 is formed of opposite halves 36a and 36b, which are connected with each other so as to serve as a torque cam, as shown in Fig. 3. The two pulley members 36a and 36b approach each other when torque which resists the rotation of the engine 3 (e.g. torque generated at the axles 8 when the truck 1 climbs a slope) increases, such that an effective diameter of the driven pulley 36 increases so as to increase the speed reduction ratio of the CVT 7.

[0015]

Next, description will be given on a centrifugal governor 34 disposed on the input shaft 5.

This centrifugal governor 34, disposed around a portion of the input shaft 5 facing toward a later-discussed output gear 51, comprises a governor weight 71, a lifter 72, a governor fork 73, a rotation shaft 74 and an output arm 75. The governor weight is a sensor, which is rotated outward according to centrifugal force so as to detect the rotational speed of the input shaft 5. The lifter 72 is slidden axially in association with the outward rotation of the

governor weight 71. The governor fork 73 is engaged with the lifter 72. The rotation shaft 74 is supported rotatably at the ceiling of the transmission casing 31, and fixedly provided thereon with the governor fork 73. The output arm 75 outputs the rotation of the rotation shaft 74 outward from the transmission casing 31.

The output arm 75 is interlocked with the throttle valve of the engine 3 through a linkage, such that the centrifugal governor 34 detects the rotational speed of the input shaft 5 and adjusts the volume of injected fuel, thereby changing the output of the engine 3 according to the variation of the rotational speed of the input shaft 5.

[0016]

Next, description will be given on the travel-direction switching mechanism 35, serving as a drive train for switching the rotational direction of the output shaft 37 relative to the rotational direction of the input shaft 5.

The input shaft 5 is notched on its periphery so as to form two gears, i.e., a forward-traveling drive gear 39 and a backward-traveling drive gear 40. In the transmission casing 31, the output shaft 37 is disposed parallel to the input shaft 5. On the output shaft 37 are disposed a relatively rotatable forward-traveling driven gear 43 and a clutch gear 44 which is not relatively rotatable but axially slidable. The forward-traveling driven gear 43, constantly engaged with the forward-traveling drive gear 39, is notched on its side face so as to form a toothed portion 43a, which can be engaged or disengaged with and from a toothed portion 44a formed on the side face of the clutch gear 44 facing the toothed portion 43a.

An idle gear 45, designated by a phantom line in Fig. 3, is constantly engaged with the backward-traveling drive gear 40. The clutch gear 44 also can be engaged or disengaged with and from the idle gear 45.

[0017]

The clutch gear 44 is axially slid so as to engage with either the

forward-traveling drive gear 43 or the idle gear 45, thereby selectively rotating the output shaft 37 in one of opposite directions.

As shown in Fig. 5, a clutch fork shaft 48 is straightly, slidably disposed adjacent to the clutch gear 44, and a clutch fork 49 is fixed onto the clutch fork shaft 48 and is engaged with the clutch gear 44. A vertical control shaft 60 is rotatably supported at the ceiling of the transmission casing 31 so as to slide the clutch fork shaft 48. An arm 61 is fixed at a basal portion thereof onto one end of the base shaft 60, and fitted at a tip portion thereof into a recess formed in the clutch fork shaft 48. The other end of the base shaft 60 projects upward from the transmission casing 31, so as to be fixedly provided thereon with a basal end of an operating arm 62. The operating arm 62 is interlocked with the above-mentioned switching lever 19, so as to allow the clutch gear 44 to slide to a forward position or a backward position.

[0018]

An end portion of the output shaft 37 is notched so as to form the output gear 51, serving as an output rotary member, for transmitting the rotation of the output shaft 37 to the differential 32.

The differential 32, as usual, includes a hollow differential casing 52, a ring gear 53, a pinion shaft 54, two bevel pinions 55, and two bevel differential side gears 56. The differential casing 52 is rotatably supported in the transmission casing 31 and disposed coaxially to the rear axles 8. The ring gear 53, serving as an input rotary member, is fixed on the outer peripheral surface of the differential casing 52, and is engaged with the output gear 51 of the output shaft 37. The pinion shaft 54 is disposed in the differential casing 52 perpendicular to the rear axles 8 so as to be rotatable integrally with the differential casing 52. The pinions 55 are rotatably supported on opposite ends of the pinion shaft 54. Each of the differential side gears 56 is fixed onto a proximal end of each of the rear axles 8 in the

transmission casing 31 so as to engage with both the pinions 55.

[0019]

Next, the axle housings 80, each of which supports each of the rear axles 8, will be described.

The two axle housings 80 are formed in the same hollow cylindrical shape. As shown in Fig. 2, the axle housings 80 are laterally symmetrically fixed at their one ends onto the transmission casing 3l, so as to cover openings formed on the left and right side faces of the transmission casing 31. The axle housings 80 are distally extended at the other ends thereof toward the outer ends of the rear axles 8. The distally extended ends of the axle housings 80 serve as support portions for journaling axial intermediate portions of the axles 8 via bearings, respectively. Consequently, the rear axles 8 are covered between their proximal ends and their axial intermediate portions by the respective axle housings 80.

[0020]

The supporting portions of the axle housings 80 are formed at external upper surfaces thereof with horizontally flat mounting portions 80a. Flat plate-shaped mounting stays 81 are fixed onto bottom ends of the bodywork frame 10, and fastened to the respective mounting portions 80a by bolts, thereby fixing and supporting the axle housings 80 to the bodywork frame 10. In such a structure, load applied to the rear wheels 9 can be supported by the transmission casing 31 through the axle housings 80, thereby simplifying the structure of the vehicle.

[0021]

The brake devices 22 for braking the rear axles 8 are disposed in the respective left and right axle housings 80.

Each of the brake devices 22 includes: friction discs 91 and second friction discs 92, which are alternately multi-laminated; a brake shoe 93 for pressuring the multi-layered friction discs 91 and 92 against one another; steel

balls 94 serving as cam members; a brake control shaft 96 with an arm 95; and the brake control arm 23. The friction discs 91 are relatively unrotatably provided onto the rear axle 8. The brake shoe 93 is fitted axially slidably and rotatably onto the transmission casing 31. Cam grooves are formed on the brake shoe 93, and each of the steel balls 94 is intervened between each of the cam grooves and the axle housing 80. The brake control shaft 96 is rotatably supported by each of the axle housings 80, and formed at one end thereof with the arm 95. The brake control arm 23 is fixed at the basal end thereof onto a portion of the brake control shaft 96 projecting the axle housing 80.

In this structure, when the brake control arms 23 are rotated, each of the brake control shafts 96 is rotated so as to the corresponding brake shoe 93 through the arm 95, so that a cam action causes between the cam grooves and the steel balls 94 to press the friction discs 91 and 92 against one another, thereby braking the rear axles 8.

[0022]

The brake devices 22 are durable and reliable wet-type brakes due to the oil filled in the axle housings 8 and the transmission casing 31.

The input shaft 5 is disposed toward the engine 3 eccentrically from the axles 8. The input shaft 5 disposed at such a low position can be sufficiently lubricated with oil splashed by rotation of the ring gear 53 of the differential 32 even if the axle housings 8 and the transmission casing 31 are filled with a little oil having a low oil level OL, as shown in Fig. 5.

[0023]

The invention is not limited to the above embodiment. The invention is broadly defined within the whole of a technological scope clarified from the present description and drawings, at which the invention truly aims.

For example, as show in Fig. 6, alternative axle housings 80' may be attached slantwise onto the transmission casing 31 so as to lower the brake

control arms 23.

[0024]

[Effect of the Invention]

The invention constructed as the above has the following effects.

[0025]

According to claim 1, in a truck including an engine mounted on a bodywork frame such that a crankshaft of the engine is horizontally oriented perpendicular to the longitudinal direction of the truck, a transmission of the truck comprises: an input shaft for receiving power of the engine through a continuously variable transmission; an output shaft disposed in parallel to the input shaft; a pair of axles extended oppositely to each other and in parallel to the output shaft; a differential connecting said axles with each other in a differential manner; a transmission casing containing the input shaft, the output shaft, the pair of axles and the differential; a pair of left and right axle housings mounted onto respective left and right faces of the transmission casing, wherein the pair of left and right axle housings house the pair of left and right axles, and wherein the pair of left and right axle housings include mounting portions to be mounted onto the bodywork frame; and a wet-type disc brake device provided around a portion of the left and right axles covered by the left and right axle housings.

Therefore, the transmission casing can receive load applied on drive wheels through the axle housings, thereby being available for simplifying the truck.

Further, this structure can be made at a low cost in comparison with the conventional structure to transmit output force of a differential to drive wheels through universal joints and a dry-type brake.

Further, the wet-type disc brake is advantageous in durability and reliability.

[0026]

As claimed in claim 2, in the transmission of a truck according to claim 1, the input shaft is eccentrically disposed from the axles toward the engine.

Therefore, the input shaft can be lowered while keeping the required distance between the input shaft and the axles. The lowered input shaft can be sufficiently lubricated by splashed oil even if the transmission casing is filled with a little lubricating oil. Consequently, the quantity of the lubricating oil can be saved so as to save manufacturing costs and weight of the transmission.

Further, a cargo deck of the truck can be lowered, thereby increasing its capacity and its center of gravity.

[0027]

As claimed in claim 3, the transmission of a truck according to claim 1 further comprises: a drive train which can switch the rotational direction of the output shaft in relation to the rotational direction of the input shaft, wherein one axial side portion of the output shaft is drivingly connected to the input shaft through the drive train; an output rotary member provided on the other axial side of the output shaft; an input rotary member of the differential, wherein the output rotary member is drivingly connected to the input rotary member; and a centrifugal governor for changing output of the engine according to variation of rotational speed of the input shaft, wherein the centrifugal governor is disposed on a portion of the input shaft facing the output rotary member.

In comparison with a torque-sensing governor, the small and inexpensive centrifugal governor is advantageous for manufacturing cost saving and miniaturization of the entire transmission.

Further, the centrifugal governor can be disposed in a dead space inside the transmission casing, so as to provide a simple and compact layout of the transmission, thereby being available for miniaturizing the

transmission.

[Brief Description of the Drawings]

[Fig. 1]

It is a general side view of a truck to which a transmission of the present invention is applied.

[Fig. 2]

It is a sectional rear elevation showing the general structure of the transmission and axles.

[Fig. 3]

It is a grossly enlarged sectional rear elevation showing the structure in a transmission casing.

[Fig. 4]

It is a side view of the transmission.

[Fig. 5]

It is a sectional side view of the transmission.

[Fig. 6]

It is a sectional side view of the transmission when modified axle housings are attached.

[Description of the Notations]

1	Truck
3	Engine
4	Transmission
5	Input Shaft
6	Crankshaft of Engine
7	CVT
8 and 8	Axles
10	Bodywork Frame
22	Wet-type Disc Brake
31	Transmission Casing (Casing of Transmission)

32	Differential
34	Centrifugal Governor
35	Forward/backward Travel Direction Switching Mechanism
37	Output Shaft
51	Output Gear (Output Rotary Member)
53	Ring Gear (Input Rotary Member of Differential)
80 and 80	Axle Housings
80a	Mounting Portion

[Document Name] Abstract

[Abstract]

[Object] An object is to provide a transmission of a truck, the truck including an engine mounted on a bodywork frame such that a crankshaft of the engine is horizontally oriented perpendicular to the longitudinal direction of the truck, the transmission including: an input shaft for receiving power of the engine through a continuously variable transmission; an output shaft disposed in parallel to the input shaft; a pair of axles extended oppositely to each other and in parallel to the output shaft; and a differential differentially connecting the axles with each other, thereby enabling the truck equipped with the transmission to be simplified and further economically produced.

[Solution] Left and right axle housings 80 covering respective axles 8 are mounted onto left and right sides of a casing 31 of the transmission. The axle housing 80 is formed with a mounting portion 80a to be connected to the bodywork frame 10, and incorporates a wet-type disc brake 22 on the axle portion.

[Selected Drawing] Fig. 2